

Amendments to the Specification:

Please replace the paragraph beginning on page 8 at line 3, starting with the words "The decoder module...", with the following rewritten paragraph:

The decoder module 216 performs Optical Character Recognition (OCR) on the bitmap primary channel 214 using decoded and decompressed assist channel 219 to produce primary channel data 112. Once accurately reconstructed using the assist ~~channel 119~~channel 118, the primary channel data 112 can be displayed on display 104 as image data 114. Accordingly, the assist channel modules 110 and 204 aid in performing OCR processing of hardcopy document image data that converts data between the hardcopy and electronic domains.

Please replace the paragraph beginning on page 8 at line 10, starting with the words "It will be appreciated...", with the following rewritten paragraph:

It will be appreciated by those skilled in the art that ~~there exists~~there exists multiple operating arrangements of the assist channel modules 110 and 204 shown in Figures 1 and 2. In some embodiments, the assist channel modules 110 and 204 are embedded in computer systems that operate integral with the display 104 or the printer 108, or that operate separate from the display 104 and printer 108. In other embodiments, the assist channel modules 110 and 204 operate integral with each other or separate from each other on one or more computer systems.

Please replace the paragraph beginning at page 16, line 7, starting with the words "With specific reference...", with the following rewritten paragraph:

With specific reference now to steps 1112, 1114, and 1116 for decoding a line of the bitmap primary channel 214. At step 214, at step 1112, a graph of the line of the primary channel is determined to define a first dimension of a product graph. At step 1114, a graph of the corresponding line of the assist channel is

determined to define a second dimension of the product graph. Finally at step 1116, the shortest path of the product of the graph of the primary channel and the graph of the assist channel is determined to produce an observed primary channel.

Please replace the paragraph beginning on page 19 at line 6, starting with the words "Figure 14 illustrates...", with the following rewritten paragraph:

Figure 14 illustrates an example of forward pass computation of the Viterbi algorithm of a graph 1400 defined by nodes 1402 the set of nodes identified from node 1401 to node 1403. The forward pass is performed in the direction indicated by arrow 1404 (i.e., forward or first direction) from node 1403 to node 1401. For simplicity, only the scores 1416 and 1418 and templates 1420 and 1422 for arcs 1406 and 1408 starting at nodes 1410 and 1412, respectively, and terminating at node 1414 are shown. In computing the shortest path for the node 1414 at step 1210, a determination is made as to whether the score and backpointers in records 1424 and 1426 of nodes 1410 and 1412, respectively, should be updated to point to node 1414 to define a shorter path. If updated the new score of node 1410 would be 19 (i.e., 12 + 7) while if updated the new score of node 1412 would be 10 (i.e., 3 + 7). Because the score of node 1410 would be improved if updated, it is updated with a new score and backpointer (see Figure 15) to node 1414 (i.e., 19 is better than 50). In contrast, the score of node 1412 would not be improved if updated with the new score from node 1414, and it is therefore not updated (i.e., 10 is worse than 8).

Please replace the paragraph beginning at page 20, line 23, starting with the words “Figure 16 illustrates...”, with the following rewritten paragraph:

Figure 16 illustrates an example of a shortest path computation of a product graph at step 1116 in Figure 11. The product graph 1600 illustrated in Figure 16 includes a first dimension 1602, defined by a graph produced at step 1112 in Figure 11, and a second dimension 1604, defined by a graph produced at step 1114 in Figure 11. The first dimension 1602 of the product graph represents a bitmap line of text of the primary channel 800 shown in Figure 8 and the second dimension 1604 of the product graph represents a corresponding line of the assist channel 900 shown in Figure 9.

Please replace the paragraph beginning at page 21, line 1, starting with the words “For illustrative purposes ...”, with the following rewritten paragraph:

For illustrative purposes the product graph 1600 shown in Figure 16 only includes the first four symbols of the primary channel (i.e., 802, 804, 806, and 808 as shown in Figure 8), the first four identifiers of the assist channel (i.e., 902, 904, 906, and 908 as shown in Figure 9), and only a few template matches. For comparison purposes, the product graph 1600 illustrates both its resulting output string 1608 and the output string produced by computing a shortest path of the graph of the bitmap primary channel in the one dimension 1602, which includes a set of arcs 1610, 1612, 1614, and 1618. Computation of the shortest path of the graph 1600 in the single dimension 1602 is performed without input from the assist channel and produces output string 1606, which includes characters “Ah a”.

Please replace the paragraph beginning at page 21, line 11, starting with the words "The product graph 1600...", with the following rewritten paragraph:

The product graph 1600 includes nodes 1640 that identify both position in the image along dimension 1602 and position in the corresponding assist channel along dimension 1604. Also, the product graph 1600 includes arcs that must be consistent with the assist channel. That is, for each arc in the first dimension with a template label and for each arc in the second dimension with a classification label, there exists a corresponding arc in the product graph if the template is in the right class. The arcs 1622, 1624, 1626, and 1628 along the second dimension 1604 correspond to the class identifiers 902, 904, 906, and 908 of Figure 9 that respectively identify the groups of symbols 702, 704, 702, and 702 shown in Figure 7, respectively. Once the product graph 1600 is defined, computing the shortest path of the product graph produces the output string 1608, which includes characters "An a".

Please replace the paragraph beginning at page 21, line 22 and extending to page 22, line 3, starting with the words "As shown in Figure 16 ...", with the following rewritten paragraph:

As shown in Figure 16, the output of an unassisted decoded primary channel 1606 is corrected using the assist channel in the product graph 1600. In defining the product graph 1600 at node 1646, the template "h" of the arc 1612, which has a computed score of 15, is excluded by the assist channel. The arc 1612 from the graph of the bitmap primary channel is excluded from the product graph because it does not satisfy the second entry in the assist channel defined by the arc 1624. That is, the template "h" identified by the arc 1612 falls in the group 702 in Figure 7 (i.e., the "a" group) instead of the group 706 group 704 (the "b" group, as shown in Figure 7) as specified by the identifier 710 of arc 1624. Consequently for the templates illustrated in Figure 16, only the template "n" of the arc 1620 that has a higher score of 19 and satisfies the second entry in the assist

Appl. No. 09/574,268
Amdt. dated June 2004
Reply to Office action of March 26, 2004

channel (i.e., arc 1624) is allowed as a valid arc at position 1642 in the product graph.

Please replace the paragraph beginning at page 22, line 22, starting with the words "It will be appreciated...", with the following rewritten paragraph:

It will be appreciated by those skilled in the art that for simplicity the product graph 1600 does not show the plurality of arcs that extend from each of the nodes 1640 and identify all the possible matches that satisfy the assist channel between templates from the template library and the bitmap primary channel. In an alternate embodiment, the number of arcs that define the product graph 1600 is reduced by including only those arcs extending from those nodes centered around the diagonal of the product graph. By allowing a generous amount of variance, this alternate embodiment assumes that the assist channel is used at a uniform rate across a line in the image.